Low Pressure Boiler Operators

STUDY GUIDE

DIVISION OF WORKERS' COMPENSATION

BUREAU OF SAFETY AND HEALTH
815 FRONT STREET
HELENA, MONTANA

Revised October, 1975

CONTENTS

GENERAL INFORMATION

This manual should rate top priority reading for all newer firemen and should serve as a guide or refresher material for senior firemen. It contains rules and suggestions which should be followed. Efficient operation is a matter of keeping the boiler clean and the firing equipment properly regulated. Since the life of the boiler is dependent upon the care it receives, special emphasis has been placed on this subject. With regular care, the boiler will last indefinitely.

The violence with which even the smaller boiler can explode should not be under-estimated. Every vessel, however small, in which water is heated can if its normal outlet is closed or plugged-up become a high pressure steam generator. If the strength of the boiler is exceeded, it will explode destructively. The recurring explosions of such low-pressure devices indicate a too widespread failure to keep this simple fact in mind. The operator of a fired water or steam vessel should insure that:

1. The vessel is of a safe construction for the pressure involved.
2. The vessel has adequate means of limitation of pressure, such as:
   a. A safety valve of proper capacity.
   b. A disk or diaphragm that will fracture at a predetermined pressure.
3. The vessel is regularly inspected, competently operated, and properly maintained.

This booklet is to assist operators in preparing themselves for taking the written examination to receive a low pressure operator's license. The operator of a pressure vessel should regard the information herein as only a beginning. He should obtain and familiarize himself with all the reference material that applies to the hazards in which he is interested. The material contained in this guide is for instructional purposes *ONLY*. In addition to knowledge of the material contained herein, the operator will be expected to pass an examination relative to the boiler and equipment that he is or will be operating.

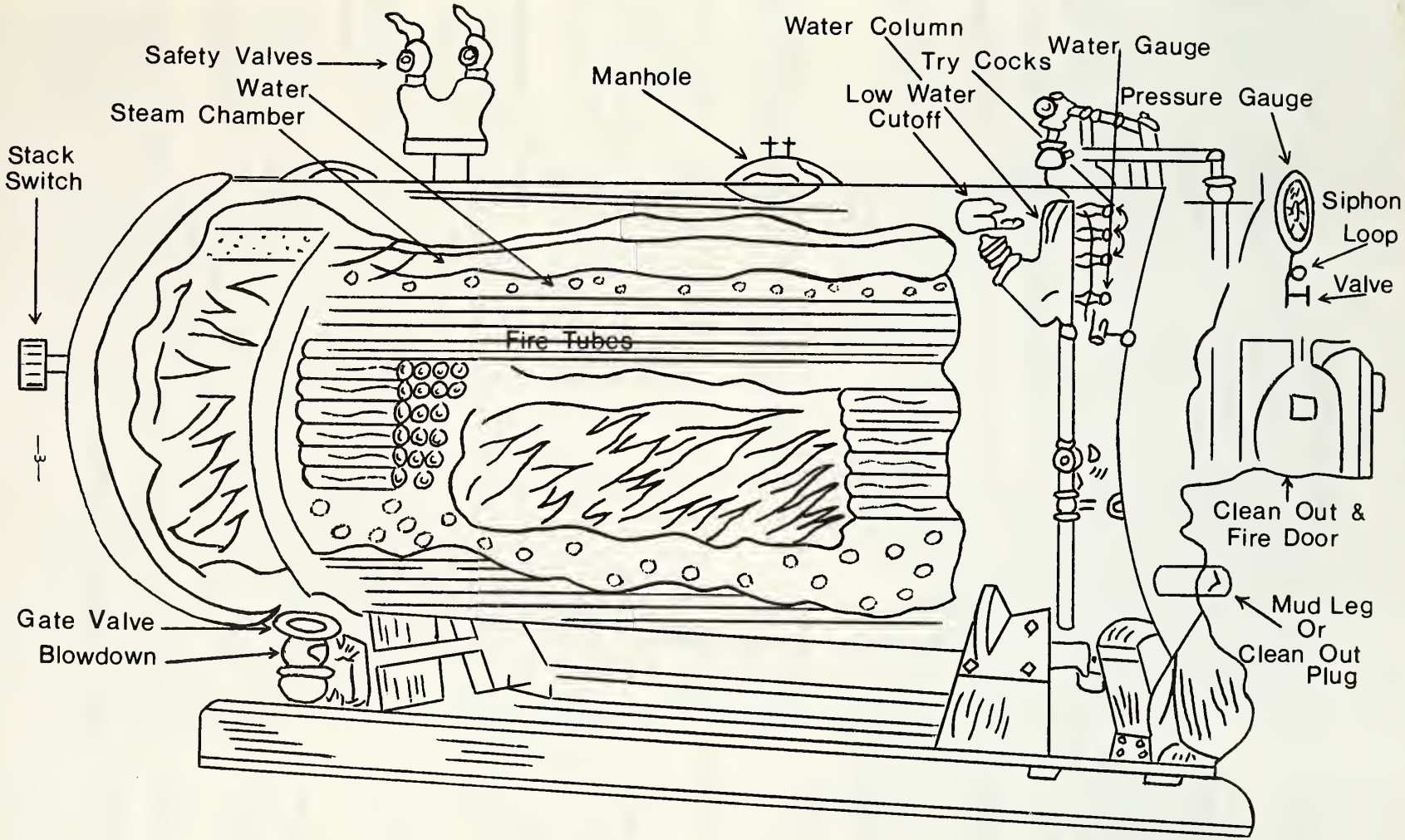
Much of the information presented in this booklet was taken from a pamphlet prepared by Alden H. Buhot, Acme Chemical Co., Milwaukee, Wisconsin. A reprint is included of the article "Why Boilers Explode" written by John Todd, Chief Inspector, Hartford Steam Boiler Inspection and Insurance Company. It would be too difficult to make individual acknowledgements as a number of people have been involved in the preparation of this booklet.

Application for license must be made to:

DIVISION OF WORKERS' COMPENSATION
Bureau of Safety and Health
815 Front Street
Helena, Montana 59601

The Applicant for Low Pressure Operator's License must:

1. Be 18 years of age or older.
2. Have at least three (3) months experience firing boilers.



EXAMPLE OF A SCOTCH MARINE BOILER AND VALVES

DEFINITIONS

BOILER —A closed pressure vessel in which a fluid is heated for use external to itself by direct application of heat resulting from the combustion of fuel (solid, liquid or gaseous) or by the use of electricity or nuclear energy.

LOW PRESSURE STEAM HEATING BOILER —A boiler operating at a pressure not exceeding 15 PSI. Normally heating boilers operate at approximately 3 to 9 PSI.

LOW PRESSURE WATER HEATING BOILERS —A boiler operating at a pressure not exceeding 160 PSI and temperature not exceeding 250 degrees for water. Normal application for HWH boilers in heating buildings is either 30 PSI or 50 PSI.

FIRE TUBE BOILER —A boiler with straight tubes that are surrounded by water and through which the products of combustion pass.

WATER TUBE BOILER —A boiler in which the tubes themselves contain steam or water, the heat being applied to the outside surface.

HEADER —The main line carrying steam or hot water from the boiler to the branch lines which supply heat to all parts of the building.

RETURN LINE —The piping which returns the water back to the boiler or return tank.

FLUE —A firetube which measures more than 4″ is called a flue.

SAFETY VALVE —An automatic pressure-relieving device. When the pressure reaches a predetermined point, the valve pops wide open and stays open until the pressure drops. It is used for steam, gas or vapor service and is normally set for 15 PSI on low pressure steam heating boilers.

GAUGE GLASS —Often referred to as the water glass; so arranged that the water in the boiler stands at roughly the same level as water in the glass. (Not found on hot water boilers.) Actually, water in a boiler under pressure is about 4 inches higher because of expansion.

TRY COCKS —Usually three in number. Located on water column or on boiler itself (locomotive boiler). Under pressure the top try cock should show steam and the lower two, water. Under vacuum air will enter through openings. Try cocks are used to check water in glass and may be used to maintain proper water level if glass is broken.

PRESSURE GAUGE —Usually attached to the upper part of the water column, it resembles a clock and indicates pounds per square inch of pressure. The gauge should always be protected from live steam by a cock valve and siphon coil. Always note the water level in the glass and the steam pressure on the gauge when entering the boiler room. Observe the reading of the steam gauge in relation with the setting of the pressuretrol.

PRESSURE —When water is boiled in a closed vessel (boiler) to form a quantity of steam, the expansion of steam leads to pressure. In low pressure boilers, the pressure is limited to 15 lbs., although the operating pressure is rarely more than 7 lbs. It is important not to raise more pressure than is needed to heat a building adequately.

PRESSURETROL —A safety or regulating device sensitive to pressure. It is normally used on steam boilers and connected, by piping and siphon loop, to the upper steam space of the boiler.

AQUATSTAT —A switching device that is sensitive to heat, located on a hot water line, coil, tank or boiler. Controls the heating or temperature of the water, turning the fuel burning equipment on or shutting it off when it reaches a given temperature.

CHECK VALVE —A valve which permits the flow of fluid in one direction only. It is used on feed water lines and fuel lines and is also located on the return line to the boiler.

FLAME FAILURE DEVICE —A combustion safeguard to shut off the fuel supply, if ignition does not occur within a predetermined period.

WATER COLUMN —A column of piping, located on the upper outside of the boiler shell to maintain a water level. Consists of try cocks, water glass gauge, low water cutoff, pressure gauge and pressuretrols.

FUSIBLE PLUG —A fusible plug is a safety device to guard against too low water level in a boiler. It is made of brass and has a hole drilled through its center. This hole is plugged with a metal that melts at about 445-450 degrees F. The plug is located in the back or front head just below the top of the highest tube. The plug melts when it loses contact with water and the fire is put out by water and steam. This device was generally used on coal fired boilers and is rarely used on new oil and gas burner type installations.

DRAFT —Draft is the movement of air which results when air is warmed. It operates best when given a free circulation thus, it is important to allow a large supply of fresh air to enter the boiler room.

DOWNDRAFT —Reverse movement of air—that is, down the chimney rather than up—is called downdraft. It usually results from faulty draft conditions, cold chimney, poor fresh air supply, closed dampers, low humidity, dirty boiler tubes and blocked tubes.

BACKDRAFT —Downdraft often leads to backdraft. When poor draft is unable to carry hot gases from the boiler, the result is that gases force themselves back into the boiler room through dampers and firedoors; and in extreme cases, backdraft can result in considerable damage.

NATURAL DRAFT —Movement of air through the boiler by other than mechanical means. The movement is due to a differential in the temperatures and pressures in the boiler room and boiler gas passages.

FORCED DRAFT —Movement of air that is forced through the boiler by mechanical means. Normally the blower or fan is located at or near the burner opening.

INDUCED DRAFT —Movement of air that is pulled through the boiler by mechanical means. Normally the blower fan is located in the breeching to the stack.

STACK SWITCH —An electronic device that is sensitive to heat. A switch usually located in the back of the boiler that shuts down the burner or draft if it does not feel heat in 60-90 seconds.

RETURN PUMP —Condensate or vacuum pump, returns condensate back to the boilers or a storage tank.

CORROSION —Corrosion is the water eating away of metal parts by impurities in air and water.

STAYBOLT —Are relatively short stays used to support parallel flat plates against bulging due to internal pressure. Some are drilled in center to leak if broken.

PRIMING —Priming occurs in a boiler when the water level is so high that water mixes with steam.

FOAMING —Caused by impurities in the water.

COMBUSTION —When a mixture of fuel and air is ignited, combustion results.

BREECHING —Piping or duct work leading from the boiler to the stack.

HYDROSTATIC TEST —A water test, not to exceed 1.5 times the maximum design working pressure, applied to the boiler pressure parts. The recommended water temperature for this test is 70 degrees F.

AUTOMATIC FEED WATER VALVE —A valve that controls the high and low water level in the boiler, opening and closing automatically.

FEED WATER TREATMENT —A chemical mixture that is fed into the boiler to prevent internal scaling or corrosion on the shell and tubes.

REVIEW QUESTIONS

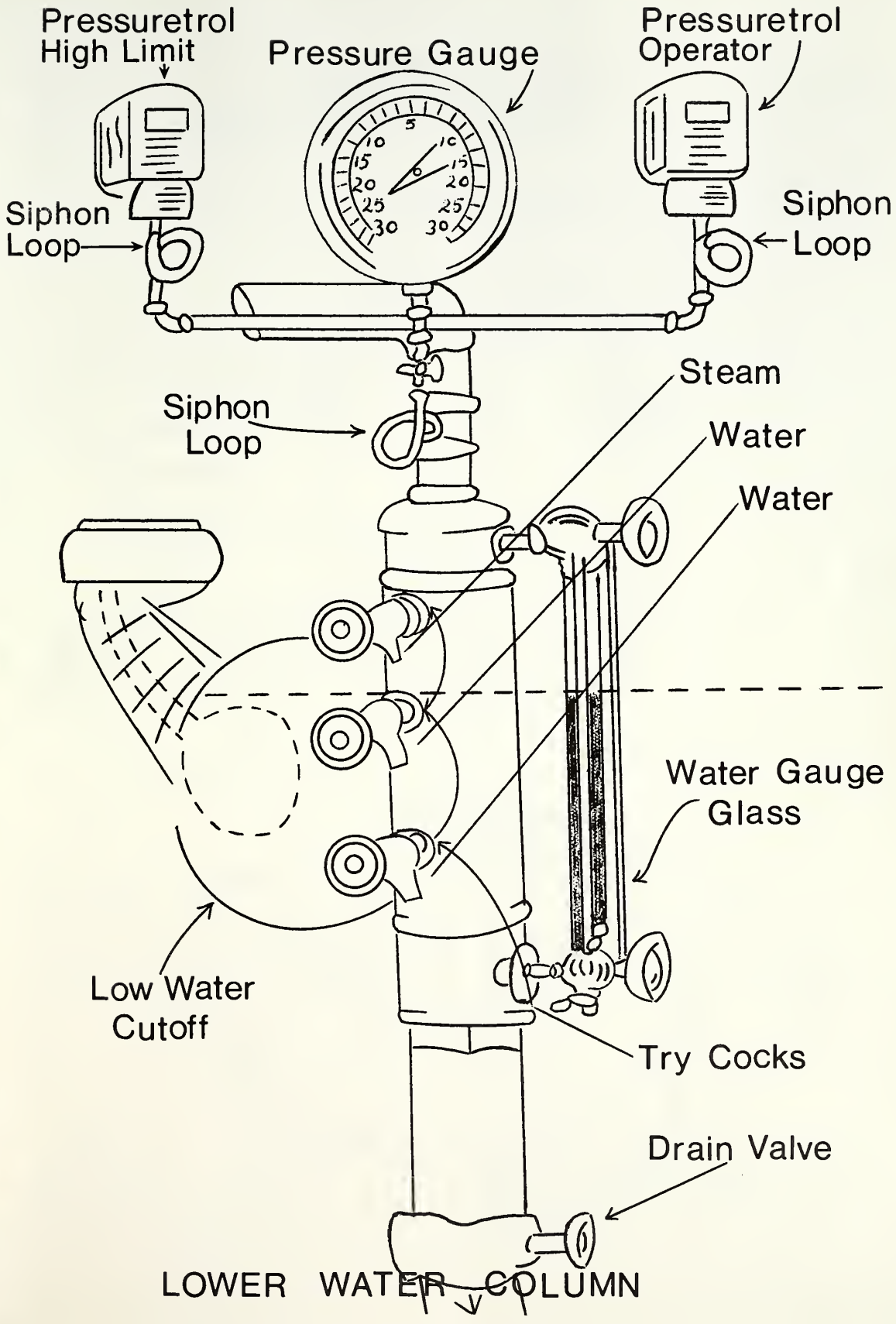
1. The main header is located on the main cold water line. True or false? Answer Ref. p. 4.

2. Explain how a check valve operates. Answer Ref. p. 4.

3. List the different types of draft. Answer Ref. p. 5.

4. The water column is located on the bottom of the boiler. True or false? Answer Ref. p. 5.

5. Gate valves are used only on the main header. True or false? Answer Ref. p. 3.


Pressuretrol
High Limit
Pressure Gauge
Pressuretrol
Operator
Siphon
Loop
Siphon
Loop
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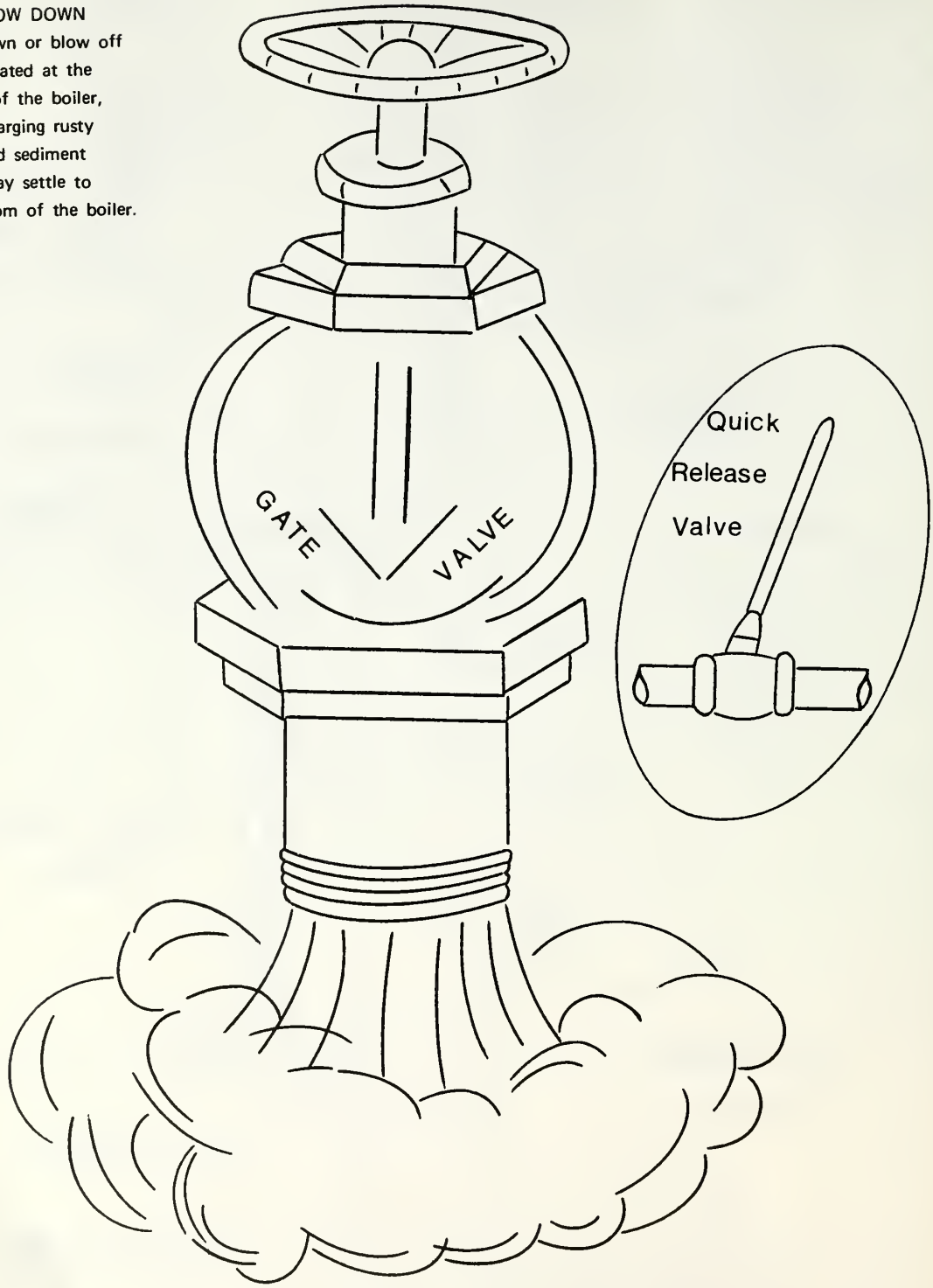
Steam
Water
Water
Water Gauge
Glass
Low Water
Cutoff
Try Cocks
Drain Valve
LOWER WATER COLUMN

BLOW DOWN

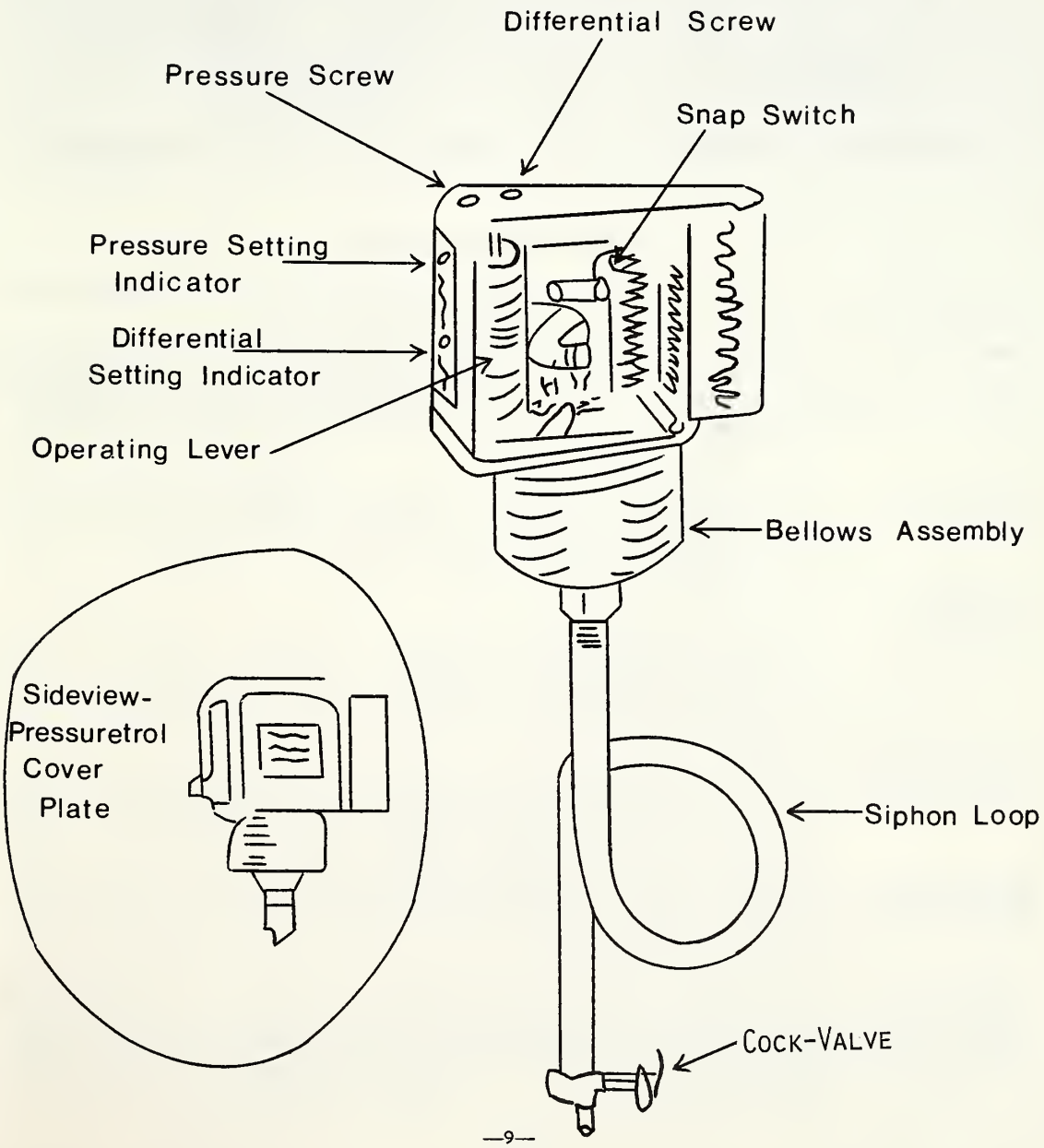
Blow down or blow off valve; located at the bottom of the boiler, for discharging rusty water and sediment which may settle to the bottom of the boiler.

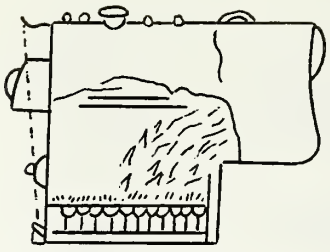


Pressuretrol

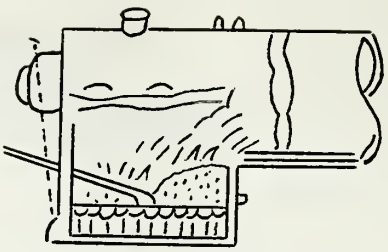
PRESSURE CONTROL

For Steam

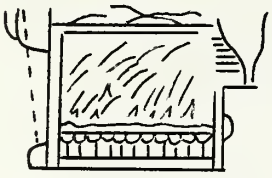




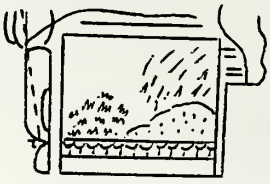
STARTING FIRE



PUSH LIVE COALS BACK



READY TO REFUEL



ADD FRESH FUEL IN FRONT

COAL BURNING BOILERS

Coal burning boilers under normal conditions—14 pounds of coal per square foot is considered an efficient average. This amount may be greatly increased through use of forced draft.

HARD COAL —Hard coal is fired as thinly as possible, just allowing the draft to pass through. Nine inches is the usual maximum depth. Unlike a soft coal fire, hard coal should never be stirred or disturbed and should be carried as level as possible without raking the top. If the fire must be sliced, a bar should be run under the fire bed poking the ashes down through the holes in the grate.

SOFT COAL —Soft coal is fired level and as thick as the draft will allow. The fire will require frequent breaking up with a bar run in next to the grate and used to pry up the fire bed. Moist or wet coal has a strong tendency to cake on the fire bed. To avoid this, coal should be kept as dry as possible.

STATIONARY GRATE —A fire built on a stationary grate has to be cleaned in two sections. First the forward half of the good fire should be pushed back and the ashes and clinkers remaining on the grate hauled out. Then all of the good fire should be pulled onto the forward half of the grate, pulled over it and out. Then the good fire may be evenly spread over the grate once more, leveled and covered with a light blanket of coal or as much as necessary.

DUMPING GRATE —A fire built on a dumping grate is cleaned by using the same procedure. First the good fire is pushed back onto the second section and front section dumped. Then the good fire is pulled forward and the rear section dumped. The fire is then spread evenly and covered with a light blanket of coal.

BANKING THE FIRE —The proper method for banking a fire is to push all the fire back against the bridge wall and then cover it thickly with coal. If this is properly done, about half of the grate surface will be left exposed.

DEAD PLATE —A dead plate is a heavy cast iron plate which is usually installed in front of the grates.

BRIDGE WALL —A bridge wall is a low brick partition at the back of the grate which prevents the fire from going back into the combustion chamber and helps to direct the flow of heat up against the boiler shell.

ROUTINE OPERATION

—Avoid sudden heating or cooling. Do not use one boiler when weather is cold enough for two.

—Check water level as often as necessary.

—Blow down water level controls frequently in steam boiler (water column daily).

—Water level in gauge glass should not fluctuate greatly. If so, find reason.

—If water is not visible in gauge glass, allow boiler to cool until shell and fire box can be handled comfortably before adding water. Always add water slowly.

—Do not bring boiler on the line until the pressure is equal to those operating.

—Do not carry more steam pressure than is absolutely required to heat buildings.

—Keep boiler room and boiler clean, orderly and well lighted.

—Maintain opening to outdoors for combustion air, with area equal to that of breech.

—Do not strike any object, tighten a bolt, nut or pipe thread under steam or air pressure.

—Do not fail to anticipate emergencies. Study every conceivable emergency and know exactly what moves to make.

—Do not fail to report unusual behavior of a boiler or other equipment to supervisor. This may be your warning of danger.

ROUTINE CLEANING

—Clean fire tubes once every month, more often if required. Brush tubes down to metal.

—Thoroughly scrape all carbon and soot from fire surfaces. The frequency of flue cleaning will depend on the fuel burned and on burner adjustments. If combustion is clean, the flues will not need to be cleaned very often. More frequent cleaning is required with coal firing due to fly ash. The flues should be examined regularly and scraped clean if coated with carbon, soot or fly ash.

—Clean smokehood and breeching.

—Clean outside of boiler. Check all accessories at this time. Clean and make sure they are in good repair. If they are in need of repair, replacements or repair orders should be made immediately.

SUMMER CLEANING

—Drain boiler, remove manhole and handhole covers, wash out plugs, hose the inside of the boiler under high water pressure and use hand scrapers to remove any mud, scale, etc. Start at the top of the boiler and work down.

—Do routine cleaning method of fire side of boiler. When boiler is to lay idle all summer, swab the fire tubes out.

—Inspect both fireside and waterside surfaces for corrosion or pitting.

—After the boiler has been thoroughly washed down, all necessary repairs should be made. Be sure that the blow off valves, water column, water glass, drain valves and feed water supply valves are in good working order and clean and closed.

—Check all parts that make up the fuel burning equipment insofar as possible, without admitting combustibles to the furnace.

—The final step for the summer lay-over period is fill the boiler to the stop valve with properly treated water. These steps should be taken in the Spring. Give your boilers immediate attention when taken out of service to prevent deterioration. (Do not fill boilers with water and allow it to stand without first heating water to steaming temperature to drive off air bubbles.)

PREPARING BOILERS FOR INSPECTION AND SUMMER STORAGE

1. First shut down all switches on panel, burner, pumps and controls, and cover electric switch.
2. Close all header valves.
3. Close all return valves to boiler and water make up.
4. Close all oil lines and gas lines.
5. Let boiler cool down overnight.
6. Open top try-cock (steam) pop-off (relief) valve (hot water).
7. Open and remove manhole cover.
8. Open blowdown valves and start draining, cleaning low water cut off by flushing at the same time.
9. Using garden hose, full pressure, flush down complete waterside of boiler through manhole opening.
10. Open wash out plugs on mud legs, front and back; wash out and clean thoroughly.
11. Remove all hand hole plates.
12. Clean breech and chimney.
13. Swing burner out and cover with canvas or cloth.
14. Open all fire doors, front and back.
15. Punch or scrape tubes (operator should wear mask protector).
16. Vacuum out soot, front and back of tube section.
17. Wire brush, scrape and clean firebox, fire chamber (operator should wear mask).
18. Clean water gauge glass, pressure gauge glass, fire-eye, ignition, oriface, burner, cup, cone, rotary and oil line filters.
19. Grease and oil all pump, fan and burner fittings.
20. Check fuel oil level and have all tanks filled to the top for summer storage.
21. Boilers should be inspected at this time.

STORAGE

22. First make all necessary repairs, replacements and painting.
23. Close all hand holes, use new gaskets.
24. Close all mud leg openings.
25. Close blow down valves.
26. Close try-cock or pop-off valve.
27. Close fireside of boiler, all openings.
28. Connect burner, open oil lines, turn on all switches.
29. Fill boiler to top with water.
30. Fire boiler and heat water in boiler for 2 hours (this will remove trapped oxygen).

PUTTING BOILER ON THE LINE

31. Replace manhole cover using new gasket.
32. Drop water in boiler to proper water level by blowing down.
33. Open all header valves and return lines.
34. Open makup water valve if automatic or by-pass, open top try cock, fire boiler, clear all trapped air and oxygen at water level until steam comes out of top try cock; then close and continue regular routine heating operation.

EQUIPMENT AND TOOLS NEEDED TO PREPARE FOR INSPECTION & STORAGE OF BOILERS

1. 50' garden hose
2. Adjustable wrench to fit man hole, wash out plugs and hand plates
3. Gaskets to fit all openings
4. Work gloves
5. Tube cleaning rod with correct brush size
6. Soot scrapers and long handled wire brush
7. Ladder, size by height of boiler
8. Industrial vacuum with attachments
9. Lube oil and oil can
10. Soot protector mask
11. Lube grease and grease gun
12. Shovel
13. Glass cleaner, clean rags and steel wool pads
14. Three empty trash (20 gal.) cans per boiler

OIL BURNER CLEANING

—Keep nozzle, strainers, electrodes, plugs, blower wheel and all filters clean. Clean fire eye glass. Stack switch should be removed annually and thoroughly cleaned. The burner service man should be consulted for any adjustments of the fuel burning equipment and controls.

CLEANING BOILER FOR INSPECTION

—The boiler must be clean and fully accessible both inside and out for inspection. Rules for summer care should be followed to prepare for inspection.

—It is recommended that the boiler operator be familiar with local laws relating to the duties of engineer and fireman and to the safety requirements of his work.

—When firemen or their superiors are seeking information about their heating equipment, it is very helpful if they have the following information available:

Boiler Number.....

Year Boiler Was Built.....

Steam or Water Boiler.....

Type of Fuel Used.....

Insurance Company Inspection No.....

—Longevity of the heating equipment is of value only in proportion to the maintenance given.

—Preparing your boiler for the winter can go a long way toward keeping the boiler in line all winter and towards insuring safe, efficient and economical operation.

REVIEW QUESTIONS

1. How often should a boiler's tubes be cleaned? a. Every 2 years b. Once a week c. Annually d. Once a month. Answer Ref. p. 11.

2. Describe the operations of the pressuretrol. Answer Ref. p. 9.

3. All low pressure heating systems should be carried at the maximum safe working pressure of the boiler at all times. True or false? Answer Ref. p. 11.

4. How is a steam gauge protected from live steam? Answer Ref. p. 4.

5. List the reasons why low pressure boilers fail or explode? Answer Ref. P. 16-17.

6. Using the Sample Inspection Report, inspect a boiler and note discrepancies found.

KNOW YOUR JOB

— Study your heating plant — Trace every pipeline — Learn the location and purpose of every valve.

— Every fireman must know the answers to the following questions:

1. What is the make and type of your boiler?
2. Fire tube? Water tube?
3. Number of Tubes?
4. Hot Water? Steam?
5. Coal (kind)? Oil (No. or grade)?
6. Name of oil burner?
7. Horsepower (steam) of boiler? (if possible)
8. Water capacity in gallons? (if possible)
9. If oil is preheated—know the temperature?
10. Number of gallons of oil burned per hour?
11. Capacity of oil tank?
12. Pressuretrol. Where located? How many?
13. High limit pressure? (At what pressure does your burner shut off?)
14. Low limit? (At what pressure does your burner switch back on?)
15. Low water cut off? Make? Location?
16. Automatic water feed? Location?
17. Hand water feed? Location?
18. Vacuum pump? Make? Location?
19. Ignition? Location? Gas? Electric?
20. Draft? Natural? Forced? Induced? Location of blower?
21. Tanks? Expansion? Condensate return? Oil? How many? Location?
22. Where does fresh air enter the boiler room?
23. Fire chamber? Metal or brick?
24. Breeching? Front? Back? (front or back of boiler?)
25. Emergency switches? (Painted red) How many? Location?
26. Wash outs, clean outs, handholes, mud legs? Manhole, clean out doors. Where? Location? How to remove and replace?
27. Fire eye? Location?
28. Stack switch? Location?
29. Aquastat? Location? Number? Temperature setting on and off?
30. Heat exchangers? Location? Purpose?
31. Check valve? Location? How many? (Do not forget to look for one on the boiler water return.)
32. Safety valves? Location? Number? (Do not forget to put chains on valves.)
33. Blow down valve? Location? Type? Number?

Reprinted with the permission of Acme Chemical Company, Milwaukee, Wisconsin, April 25, 1968

WHY BOILERS EXPLODE

By JOHN TODD, Chief Inspector
New York Branch Office
Hartford Steam Boiler Inspection and Insurance Co.
Reprinted from POWER, *July, 1964*

—We asked John Todd for the reasons, since he is a highly respected authority in the field of boiler explosions. His experience points up one fundamental shortcoming—**the assumption by owners that a boiler built to standards and furnished with automatic controls requires no expert attention.**

—**Q** WITH THE MANY SAFETY DEVICES AND AUTOMATIC CONTROLS ON PRESENT-DAY BOILERS, WHY ARE THERE SO MANY BOILER FAILURES?

—**A** The main reason, in my opinion, is the lowering or complete absence of operating standards. Too many owners have only one thought in mind when buying boilers provided with automatic controls—they hope to operate without the benefit of qualified operators. Please remember that until such time as all interested parties (these include governmental and insurance company inspectors, boiler manufacturers, code-making organizations and engineers) can convince boiler owners that they cannot shed all responsibilities toward safe operating practices by substituting automatic devices, boiler accidents will continue at the present alarming rate.

—**Q** WHAT IS THE MOST COMMON TYPE OF BOILER ACCIDENT OCCURRING TODAY?

—**A** The greatest accident producer today is low water which usually results in over heating and loosening of tubes, collapse of furnaces, and in some cases, complete destruction of the boiler. In certain classes of boilers a low-water condition can set the stage for a disastrous explosion that can cause serious loss.

—**Q** WHY IS LOW WATER RESPONSIBLE FOR MOST BOILER ACCIDENTS IN THE PAST DECADE?

—**A** Primarily it is due to a lack of boiler operating and maintenance standards. This is true despite the fact that most boilers, especially heating ones, are provided with automatic feed devices, just one of the many automatic controls. But it is these devices that lull the owners into a false sense of security. Many of them feel that the boiler is fully automatic and completely protected from accidents. Not understanding fully how potentially dangerous a fired pressure vessel can be, the owner (or any one else) does not seem to take the slightest interest after installing one of these so-called automatic boilers.

The fact is that automatic feed devices, like all other automatic devices, will work perhaps a thousand times, perhaps many thousand times. But at some time they will probably fail, usually with disasterous results. That is why it's the duty of everyone concerned with boilers to realize that unless proper operating and maintenance standards are instituted, accidents are certain to occur.

—**Q** YOU SAID THAT LOW-WATER ACCIDENTS ARE CAUSED PRIMARILY BY FAILURE OF AUTOMATIC FEED DEVICES. BUT ISN'T IT TRUE THAT, IN PRACTICALLY ALL CASES, LOW-WATER FUEL CUTOUTS ARE INSTALLED ON ALL AUTOMATICALLY-FIRED BOILERS TO PROTECT THE BOILER FROM OVERHEATING, IN THE EVENT OF FAILURE OF THE FEEDING DEVICE? IF SUCH IS THE CASE, WHAT CAUSES THE FAILURE?

—**A** That's correct. Practically all boilers today are provided with low-water fuel cutouts. What most people don't realize is that, as is true in most accidents regardless of the type of cutouts, a series of failures occurs. Thus, the basic fault may be failure of the automatic feed device to operate. Then we experience failure of the low-water fuel cutout. The net result is overheating and burning of the boiler metal. The failure of the automatic feed device and the subsequent failure of the low-water fuel cutout to operate stem from the same basic cause—lack of operating and maintenance standards practiced by the owner.

—**Q** HOW SHOULD A LOW-WATER CUTOUT BE TESTED?

—**A** The only positive method of testing a LWCO is by duplicating an actual low-water condition. This is done by draining the boiler slowly while under pressure. Draining is done through the boiler blowdown line. We find that many heating boilers are not provided with facilities for proper draining—an important consideration.

Many operators mistakenly feel that draining the float chamber of the cutout is the proper test. But this particular drain line is only provided for blowing out sediment that may collect in the float chamber. In most cases the float will drop when this drain is opened due to the sudden rush of water from the float chamber. Every boiler inspector can tell you of numerous experiences of draining the float chamber and having the cutout perform satisfactorily. But when proper testing was done by draining the boiler, the cutout failed to function.

—Q WHAT PERCENTAGE OF BOILER LOSSES ARE CAUSED BY LOW WATER?

—A Approximately 75 per cent.

—Q VARIOUS ARTICLES HAVE BEEN PUBLISHED ON THE SUBJECT OF SAFETY VALVES, PARTICULARLY THE LOW-PRESSURE TYPE WITH A SETTING OF ONLY 15 PSI. IF IT IS TRUE THAT ALL BOILERS FURNISHED TODAY ARE PROVIDED WITH ASME—APPROVED VALVES, WHY SHOULD ANYONE TAKE EXCEPTION TO THEM AND WHY SHOULDN'T THEY WORK?

—A In the first place, most people have a misconception of the term "ASME—approved." To set the record straight, the ASME itself does not approve a type of safety valve. By referring to the ASME Code, Section I —Power Boilers, and Section IV—Low Pressure Heating Boilers, you will see that both Codes contain limited design criteria. The Codes also require a manufacturer to submit valves for testing. Such tests are solely for pressure-setting and relieving capacity.

In brief, the ASME symbol on a safety valve attests to the fact that the limited design criteria and the materials outlined in the code have been supplied by the manufacturer and that the relieving capacity and set pressure stamped on the valve have been proved.

Getting back to the first part of your specific questions, in some cases experience indicates that a particular type of safety valve has an inherent design weakness. After a short period of operation, the disk may be subject to sticking due to close clearances. This condition will render the valve useless, and the boiler will be without the benefit of over-pressure protection.

In regard to the second part of your question, the failure of safety valves to work is usually due to build-up of foreign deposits that result in "freezing." This is an indication that the valve has not been regularly tested or examined. One of the greatest causes of foreign deposit build-up is due to a "weeping" or leaking condition. The only way to be sure that a valve is in proper operating condition is to set up and adhere to a regular program of testing the valves by hand while the boiler is under pressure. Also, any weeping or leaking valve should be immediately replaced or repaired. This is important.

—Q HOW OFTEN AND IN WHAT MANNER SHOULD BOILER SAFETY VALVES BE TESTED TO MAKE CERTAIN THEY ARE IN PROPER WORKING ORDER?

—A Low pressure (15psi) safety valves should be lifted at least once a month while the boiler is under steam pressure. The valve should be opened fully and the try lever released, so the valve will snap closed. For boilers operating between 16 and 225 psi, the safety valves should be tested weekly by lifting the valves by hand. On these higher-pressure boilers it is good practice to test the safety valves by raising the pressure on the boiler. This can usually be done when the boiler is being taken off the line. Then, if the valve feathers from improper seating, it can be corrected when the boiler is cold.

—Q WHAT CAN BE DONE TO PREVENT BOILER FAILURES?

—A Boiler failures can at least be greatly reduced if boilers are placed under the custody of properly trained operators. This means that boiler owners must use sound judgment when employing boiler operators. Everyone with an interest in boilers must be encouraged in educating boiler owners and operators in proper operating procedures.

A very important step is establishing a regular program for testing of controls and safety devices then faithfully following through.

Further, a program must be established for periodic maintenance of controls and safety devices. First thing to realize is that providing boilers with the most modern proved controls and safety devices is no guarantee that you will not have boiler failures. Any control or safety device is only as good as the testing and maintenance it receives. You cannot ever relax on these two.

—Q WHAT CAN A BOILER OWNER DO TO ASSURE THAT HE HAS TAKEN ALL POSSIBLE STEPS TO PREVENT BOILER FAILURE?

—A First, purchase the best equipment available for a given service. Second, make certain that the boiler is properly installed and equipped with all the necessary appurtenances and safety devices. Third, before taking final acceptance, specify that the installation be inspected by a commissioned inspector in the employ of an insurance company or the state or municipality. By doing so, the owner will be assured that the equipment and the installation meet the legal requirements of the particular state or municipality. Fourth, the owner should provide the operator with a log book and a set of preventive maintenance and testing procedures. He should insist that such procedures be followed religiously and that the results of the tests and maintenance be recorded and be made a permanent part of the boiler room log.

ASME Section IV

SAFETY VALVE CAPACITY

TABLE HG 400.1

Minimum pounds of steam per hour per square foot of heating surface:

Boiler Heating Surface	Fire Tube	Water Tube
Hand Fire	5	6
Stoker fired	7	8
Oil, gas or pulverized fuel fired	8	10

(d) The minimum valve capacity in pounds per hour shall be the greater of that determined by dividing the maximum BTU output at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000, or shall be determined on the basis of the pounds per hour per square foot of boiler heating surface as given in Table HG 400.1.

(e) The safety valve capacity for each steam boiler shall be such that with the fuel burning equipment installed, and operated at maximum capacity, the pressure cannot rise more than 5 psi above the maximum allowable working pressure.

(f) Example for determining the minimum safety valve capacity by use of the above chart:

A boiler has 100 sq. ft. of heating surface, fire tube type, and is gas fired. $100 \times 8 = 800$ lbs. per hour that the boiler will generate, therefore the minimum safety valve capacity would be 800 lbs. per hour discharge.

BUREAU OF SAFETY AND HEALTH
DIVISION OF WORKERS' COMPENSATION

815 Front Street

Helena, Montana 59601

BOILER INSPECTION REPORT

1 | DATE INSPECTED MO. DAY YEAR | CERT. EXP. DATE MO YEAR | CERTIFICATE POSTED ☐ YES ☐ NO | OWNER NO. | STATE NUMBER | NAT'L BD. NO. ☐ OTHER NO. ☐

2 | OWNER | NATURE OF BUSINESS | KIND OF INSPECTION ☐ INT. ☐ EXT. | CERTIFICATE INSPECTION ☐ YES ☐ NO

OWNER STREET ADDRESS NUMBER | OWNERS CITY | STATE | ZIP

3 | USERS NAME--OBJECT LOCATION | SPECIFIC LOCATION IN PLANT | OBJECT LOCATION--COUNTY

USERS STREET ADDRESS NUMBER | USERS CITY | STATE | ZIP

4 | TYPE ☐ FT. ☐ WT. ☐ CI ☐ OTHER _____ | YEAR BUILT | MANUFACTURER

5 | USE ☐ POWER ☐ PROCESS ☐ STEAM HTG. ☐ HWH ☐ HWS ☐ OTHER _____ | FUEL | METHOD OF FIRING | PRESSURE GAGE TESTED ☐ YES ☐ NO

6 | PRESSURE ALLOWED THIS INSPECTION _____ PREV. INSPECTION _____ | SAFETY-RELIEF VALVES SET AT _____ | EXPLAIN IF PRESSURE CHANGED

7 | IS CONDITION OF OBJECT SUCH THAT A CERTIFICATE MAY BE ISSUED? ☐ YES ☐ NO (IF NO EXPLAIN FULLY UNDER CONDITIONS) | HYDRO TEST ☐ YES _____ PSI. DATE _____ ☐ NO

8 | CONDITIONS: With respect to the internol surfoce, describe and state location of ony scole, oil or other deposits. Give location and extent of ony corrosion and state whether active or inoctive. Stote locotion and extent of any erosion, groaving, bulging, warping, cracking or similar condition. Report on any defective rivets, bowed, loose or broken stays. State condition of all tubes, tube ends, coils, nipples, etc. Describe any adverse conditions with respect to pressure goge, woter column, gage glass, gage cocks, sofety valves, etc. Report condition of setting, linings, boffles, supports, etc. Describe any major changes or repairs made since last inspection.

9 REQUIREMENTS: (LIST CODE VIOLATIONS)

10 NAME AND TITLE OF PERSON TO WHOM REQUIREMENTS WERE EXPLAINED:

I HEREBY CERTIFY THIS IS A TRUE REPORT OF MY INSPECTION

SIGNATURE OF INSPECTOR	IDENT. NO.	EMPLOYED BY	IDENT. NO.

Form 636-Trip

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